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Statistical Series 2000-18



Alberta's Reserves 1999

Volume 2 of 2

**Ethane
NGL
Sulphur**

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ALBERTA ENERGY AND UTILITIES BOARD
Statistical Series 18: Alberta's Reserves 1999, Volume 2

ISSN 0706-3199

June 2000

Published by

Alberta Energy and Utilities Board
640 – 5 Avenue SW
Calgary, Alberta
T2P 3G4

Telephone: (403) 297-8311
Fax: (403) 297-7040

Web site: www.eub.gov.ab.ca

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Overview

What This Report Contains

This is Volume 2 of *Alberta's Reserves Report 1999*, which is updated and published annually by the Alberta Energy and Utilities Board (EUB). Volume 2 includes estimates of reserves for ethane, natural gas liquids, and sulphur. This edition reflects changes that have occurred to the end of 1999.

This is the first time that *Alberta's Reserves* (Statistical Series 18) has been separated into two volumes. Volume 1 was released in May 2000 and includes reserves of crude oil, oil sands, and natural gas.

The following table provides summary information on ethane, NGL, and sulphur reserves based on the EUB's estimate of established gas reserves. The increase in initial established reserves of ethane and NGL is the result of the increase in initial established gas reserves. Initial established reserves of sulphur increased due mainly to an increase in bitumen reserves under active development (see Volume 1 of this report for details).

Reserve Highlights 1999		
Reserves	1999	Change from 1998
Ethane		
Initial established (10^6 m ³)	739.0	+14.2
Cumulative net production	483.0	+26.2
Remaining established (10^6 m ³)	256.0	-12.0
NGL		
Initial established (10^6 m ³)	766.0	+4.0
Cumulative net production	552.3	+21.2
Remaining established (10^6 m ³)	213.7	-17.2
Sulphur		
Initial established (10^6 t)	309.0	+27.9
Cumulative production	199.8	+7.8
Remaining established (10^6 t)	109.2	+20.1

The EUB estimates yet-to-be-established gas reserves of 1681 billion cubic metres. This will yield reserves yet to be established for ethane and NGL of 291 and 394 million cubic metres respectively. Likewise, 128.7 million tonnes of sulphur are yet to be established from future gas discoveries, not to mention significant quantities of sulphur that will be recovered from the production of crude bitumen.

The Terminology section lists metric units and the imperial equivalents used in tables throughout the report, a glossary of specialized terminology, and symbols and abbreviations used in the report.

For More Information

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1 Reserves of Ethane

This section discusses the 1999 production of ethane and represents the EUB's estimate of the total volume of ethane contained in the remaining established reserves of gas.

Although the EUB believes that ethane extraction at crude oil refineries and at plants processing synthetic crude oil might become viable in the future, it has not attempted to estimate the prospective reserves from those sources.

1.1 Provincial Summary

A computer file of compositional gas analyses and remaining established reserves was used in preparing the ethane reserve estimates in this section. Where a gas analysis was not available for a particular pool, a field or area average for the zone was used. The EUB estimates the remaining ethane volume from the total remaining established reserves of marketable gas to be 256 million cubic metres in liquefied form or 72.1 billion cubic metres in gaseous form. This estimate includes 28 million cubic metres recoverable from the ethane component of the solvent bank injected into several pools throughout the province to enhance oil recovery. Based on the EUB's estimated ultimate potential of 1030 million cubic metres, there remains 291 million cubic metres yet to be established. The overall changes in reserves during the past year are shown in Table 1.1.

Table 1.1 Ethane reserves (10^6 m^3) in liquefied form as of December 31, 1999

	1999	1998	Change
Initial established	739.0	724.8	+14.2
Cumulative net production	483.0	456.8	+26.2
Remaining established	256.0	268.0	-12.0

For individual gas pools, the ethane content of marketable gas in Alberta falls within the range of 0.0025 to 0.20 mole per mole. As shown in Table 1.2, the volume-weighted average ethane content of all remaining established marketable gas was 0.053 mole per mole. This table also gives a breakdown of ethane volumes recoverable from major fields, all other remaining fields, and solvent floods. Fields with liquid ethane reserves greater than 3 million cubic metres are classified as major fields and are listed in Table 1.3.

1.2 Ethane Extraction

The three principle sources of ethane extraction from natural gas are field plants with deep-cut facilities, fractionation plants, and straddle plants. Straddle plants extract the majority of ethane while the volume of extraction from fractionation plants is growing. Field plants with deep-cut facilities represent a small portion of the ethane recovered. Table 1.4 shows ethane extraction volumes at the three plant types in 1999.

Table 1.2. Remaining ethane reserves as of December 31, 1999

Fields	Remaining established reserves of marketable gas (10 ⁹ m ³)	Ethane content (mol/mol)	Volume of ethane	
			Gas (10 ⁹ m ³)	Liquid (10 ⁶ m ³)
Major fields with liquid ethane reserves > 3.0 10 ⁶ m ³	190.0	0.099	18.8	67
All other fields with ethane reserves	<u>1 017.0</u>	<u>0.045</u>	<u>45.3</u>	<u>161</u>
Subtotal	1 207.0	0.053	64.1	228
Recoverable from solvent floods			<u>8.0</u>	<u>28</u>
Provincial total			72.1	256

Table 1.3. Major fields with liquid ethane reserves > 3 10⁶ m³ as of December 31, 1999

Fields	Remaining established reserves of marketable gas (10 ⁹ m ³)	Ethane content (mol/mol)	Volume of ethane	
			Gas (10 ⁹ m ³)	Liquid (10 ⁶ m ³)
Bonnie Glen	7	0.162	1.1	3.9
Brazeau River	17	0.095	1.6	5.7
Caroline	16	0.175	2.9	10.1
Elmworth	20	0.062	1.2	4.3
Garrington	10	0.106	1.1	3.9
Kaybob South	16	0.100	1.6	5.7
Pembina	25	0.093	2.3	8.3
Rainbow	13	0.117	1.5	5.3
Ricinus	16	0.083	1.3	4.7
Valhalla	15	0.073	1.1	3.9
Wapiti	16	0.071	1.1	4.0
Willesden Green	13	0.078	1.0	3.6
Wizard Lake	<u>6</u>	<u>0.150</u>	<u>1.0</u>	<u>3.4</u>
Total	190	0.099	18.8	66.8

In 1999 ethane extracted at gas processing facilities increased 9 per cent to 11.3 million cubic metres from 10.3 million cubic metres in 1998. The Dow Fort Saskatchewan plant saw a major increase in ethane recovery late in 1999.

Table 1.4 Ethane extraction volumes at the three plant types during 1999

Plants	Volume (10 ⁶ m ³)
Straddle	6.4
Fractionation plants	4.0
Gas plants	<u>0.9</u>
Total	11.3

Presently some 80 per cent of extracted ethane is used by the petrochemical industry as feedstock to produce ethylene, while the remainder is exported out of the province. In 1999 some 43 per cent of ethane was extracted from natural gas, while the remainder was left in the gas stream and used for its heating value. As the industry continues to grow, the demand for ethane also increases. By applying present technology to ethane recovery processes, some 80 per cent of ethane contained in Alberta's gas production could be recovered.

2 Reserves of Natural Gas Liquids

Natural gas liquids (NGL) are defined in the Oil and Gas Conservation Act as “propane, butanes, or pentanes plus, or a combination of them, obtained from the processing of raw gas or condensate.”

2.1 Provincial Summary

The EUB estimates the remaining established reserves of natural gas liquids in Alberta as of December 31, 1999, to be 213.7 million cubic metres. This represents a net decrease of 17.2 million cubic metres since December 31, 1998. Based on the EUB's estimated ultimate potential of 1 160 million cubic metres of natural gas liquids, there remains 394 million cubic metres yet to be established. The overall changes in the reserves during the past year are shown in Table 2.1. The fields with the largest changes for 1999 are shown in Table 2.2.

Table 2.1. Reserves of natural gas liquids (10⁶ m³) as of December 31, 1999

	1999	1998	Change
Initial established			
Propane	269.0	266.8	+2.2
Butanes	155.7	154.3	+1.4
Pentanes plus	<u>341.3</u>	<u>340.9</u>	<u>+0.4</u>
Total	766.0	762.0	+4.0
Cumulative net production ^a			
Propane	186.4	178.2	+8.2 ^b
Butanes	107.1	103.2	+3.9 ^b
Pentanes plus	<u>258.8</u>	<u>249.7</u>	<u>+9.1^b</u>
Total	552.3	531.1	+21.2
Remaining established			
Propane	82.6	88.6	-6.0
Butanes	48.6	51.1	-2.5
Pentanes plus	<u>82.5</u>	<u>91.2</u>	<u>-8.7</u>
Total	213.7	230.9	-17.2

^a Net production means production less those volumes returned to the formation or injected to enhance the recovery of oil.

^b Discrepancies may exist with actual production as reported in *Statistical Series 2000-17*.

Also during 1999, propane and butanes recovery at crude oil refineries was 354.15 and 899.2 thousand cubic metres respectively.

2.2 Determination of Recoverable Reserves of Natural Gas Liquids

The remaining established reserves of natural gas liquids consist of liquids that are expected to be extracted from the province's remaining established reserves of raw gas. The liquids recoverable from pools currently producing and connected to field gas processing plants were generally determined using remaining recoverable raw gas reserves, a raw gas analysis, and the current plant recovery efficiency for each component. For retrograde condensate pools where gas is cycled, product recoveries have been

Table 2.2. Major natural gas liquids reserves changes (10^3 m^3), 1999

Field	Remaining established 1999	Reserves change	Main reason for change
Brazeau River	5285	-1414	Reevaluation of reserves
Elmworth	2866	+724	Reevaluation of reserves
Gold Creek	620	-1123	Reevaluation of reserves
Karr	1776	-1868	Reevaluation of reserves
Wapiti	2367	+1419	Reevaluation of reserves

determined from individual reservoir studies, having regard for anticipated future cycling and blowdown operations. The remaining established reserves also include NGL estimated for unconnected reserves.

Table 2.3 shows the natural gas liquid reserves broken down into connected, unconnected, and solvent flood categories.

Table 2.3 Remaining established reserves (10^6 m^3) as of December 31, 1999

	Propane	Butanes	Pentanes plus	Total
Connected	68.2	39.6	70.5	178.3
Unconnected	14.1	7.7	11.4	33.2
Solvent floods	<u>0.3</u>	<u>1.3</u>	<u>0.6</u>	<u>2.2</u>
Total	82.6	48.6	82.5	213.7

Natural gas liquids are also recoverable at straddle plants. This volume is estimated by multiplying the remaining marketable gas reserves by the historic ratio of liquid production to marketable gas production. This assumes that the liquid content of marketable gas volume to be processed at straddle plants will remain constant. The EUB believes that the approach gives a reasonable indication of the natural gas liquids recoverable at these plants. The volumes recoverable at straddle plants are not included in the field totals and are shown separately in Table 2.4. Also listed in Table 2.4 are fields containing 800 000 cubic metres or more of recoverable reserves, while those with less are grouped under confidential and other small reserves categories. Note that some fields containing less than 800 000 cubic metres have been listed individually in this table for historical reasons.

2.3 Extraction of Propane, Butanes, and Pentanes Plus

Natural gas liquids are recovered from several sources, including gas processing plants in the field that extract propane, butanes, and pentanes plus as products or recover an NGL mix from raw gas production. NGL mixes are sent from gas processing plants to fractionation plants to recover individual NGL products. Straddle plants, usually at border points, also recover NGL products from marketable natural gas. A portion of the NGL mix from straddle plants is fractionated into individual products outside Alberta.

Propane is used in space heating, motor vehicles, barbecues, grain drying, and many other areas where an easily transportable fuel is required. The major use of butanes is as a feedstock in the production of methyl-tertiary-butyl-ether (MTBE), which when added to gasoline is an octane enhancer. Pentanes plus is a very light crude oil used as refinery feedstock for the production of gasoline and as a diluent to enable transportation of heavy crude oil and bitumen.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999

Field	Zone	2	3			6			9
		Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)			Total
			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	
Ansell	Cardium	3 056	61	97	192	187	297	588	1 072
	Mannville	1 181	22	39	72	26	46	85	157
	Viking	503	14	18	84	7	9	42	58
	Other	170	-	15	60	1	1	10	12
	Subtotal					220	352	715	1 287
Bonnie Glen	Cardium	65	1 677	62	62	109	4	4	117
	Mannville	455	59	35	37	27	16	17	60
	Leduc ^a	6 310	-	-	-	644	340	739	1 723
	Subtotal					780	360	760	1 900
Brazeau River	Belly River	2 085	95	46	72	198	96	151	445
	Cardium	543	15	7	142	8	4	77	89
	Mannville	1 790	20	12	275	36	22	492	550
	Jurassic	2 963	75	43	218	222	126	647	995
	Rundle	2 655	1	-	82	2	1	218	221
	Upper Devonian	72	97	42	14	7	3	1	11
	Winterburn ^a	6 634	-	-	-	355	376	2 243	2 974
	Subtotal					828	628	3 829	5 285
Caroline	Cardium	1 417	157	93	174	222	132	246	600
	Mannville	3 218	136	72	154	438	233	497	1 168
	Viking	308	120	62	78	37	19	24	80
	Rundle	1 219	67	41	45	82	50	55	187
	Beaverhill Lake	9 187	417	525	1 358	3 833	4 823	12 478	21 134
	Subtotal					4 612	5 257	13 300	23 169
Cranberry	Beaverhill Lake	3 013	65	67	204	196	202	614	1 012
	Middle Devonian	218	5	5	50	1	1	11	13
	Subtotal					197	203	625	1 025
Crossfield	Viking	124	89	65	56	11	8	7	26
	Mannville	1 548	61	42	99	95	65	153	313
	Jurassic	37	54	108	162	2	4	6	12
	Mississippian ^a	2 134	-	-	-	103	127	184	414
	Wabamun	1 843	7	5	28	12	10	51	73
	Subtotal					223	214	401	838
Dunvegan	Triassic	586	51	29	36	30	17	21	68
	Belloy	126	-	-	79	-	-	10	10
	Mississippian	257	12	8	66	3	2	17	22
	Rundle	8 008	64	38	87	516	308	697	1 521
	Wabamun	281	110	71	192	31	20	54	105
	Subtotal					580	347	799	1 726

(continued)

^aIncludes gas cycling pool. Gas reserves calculated on an energy basis. Liquid recovery ratios are not included because of parameters changing with time.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Field	Zone	1 Remaining reserves of marketable gas (10 ⁶ m ³)	2 Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			3 Remaining established reserves of natural gas liquids (10 ³ m ³)			9 Total
			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	
Edson	Cardium	787	100	67	197	79	53	155	287
	Viking	406	22	15	81	9	6	33	48
	Mannville	1 753	72	40	111	127	70	195	392
	Jurassic	876	48	29	135	42	25	118	185
	Rundle	824	-	-	100	-	-	82	82
	Upper Devonian	512	-	-	158	-	-	81	81
	Other	174	-	2	20	-	1	10	11
	Subtotal					257	154	664	1 075
Elmworth	Second White Specks	1 353	143	72	61	193	97	82	372
	Lower Cretaceous	1 560	43	21	31	67	33	49	149
	Mannville	13 269	61	30	62	812	402	823	2 037
	Triassic	1 327	51	52	129	68	69	171	308
	Other	2 112	51	2	8	7	3	10	20
	Subtotal					1 140	601	1 125	2 866
Ferrier	Belly River	351	134	43	46	47	15	16	78
	Cardium	2 794	146	36	50	408	101	141	650
	Mannville	2 296	107	55	107	246	126	246	618
	Viking	186	124	48	70	23	9	13	45
	Jurassic	670	137	69	87	92	46	58	196
	Rundle	1 987	29	22	90	58	43	178	279
	Mississippian	829	64	41	90	53	34	75	162
	Subtotal					927	374	727	2 028
Garrington	Cardium	95	95	53	158	9	5	15	29
	Viking	212	104	52	94	22	11	20	53
	Mannville	5 757	200	92	74	1 149	531	424	2 104
	Jurassic	178	107	73	146	19	13	26	58
	Rundle	683	111	86	94	76	59	64	199
	Wabamun	1 514	58	79	123	88	119	186	393
	Leduc	1 844	34	40	81	62	73	149	284
	Subtotal					1 425	811	884	3 120
Gilby	Belly River	85	47	59	35	4	5	3	12
	Second White Specks	102	88	78	59	9	8	6	23
	Mannville	2 433	66	49	64	161	120	156	437
	Jurassic	1 476	51	41	47	75	60	69	204
	Rundle	2 380	42	42	45	101	99	106	306
	Wabamun	61	131	66	49	8	4	3	15
	Leduc	72	111	69	83	8	5	6	19
	Subtotal					366	301	349	1 016
Gold Creek	Second White Specks	56	125	54	36	7	3	2	12
	Mannville	1 807	26	15	56	47	27	102	176
	Triassic	1 430	12	6	31	17	8	45	70
	Wabamun	3 565	-	-	102	-	-	362	362
	Subtotal					71	38	511	620

(continued)

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Field	Zone	1	2	3	4	5	6	7	8	9
		Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)				
			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	Total	
Hamburg	Triassic	165	12	6	42	2	1	7	10	
	Beaverhill Lake	3 826	17	20	209	66	78	798	942	
	Subtotal					68	79	805	952	
Harmattan East	Viking	112	89	107	80	10	12	9	31	
	Mannville	428	121	143	131	52	61	56	169	
	Mississippian ^a	6 010	-	-	-	12	8	13	33	
	Subtotal					74	81	78	233	
Harmattan-Elkton	Mississippian ^a	6 393	-	-	-	92	68	191	351	
	Subtotal					92	68	191	351	
Hussar	Viking	437	14	7	21	6	3	9	18	
	Mannville	4 217	67	41	63	284	175	267	726	
	Rundle	94	96	53	53	9	5	5	19	
	Other	3 976	96	21	43	4	2	4	10	
	Subtotal					299	183	281	763	
Judy Creek	Viking	626	6	5	50	4	3	31	38	
	Beaverhill Lake	2 444	255	135	87	622	329	212	1 163	
	Subtotal					626	332	243	1 201	
Jumping Pound West	Rundle	10 380	29	27	88	300	277	910	1 487	
	Subtotal					300	277	910	1 487	
Karr	Cardium	86	81	35	47	7	3	4	14	
	Second White Specks	231	104	48	48	24	11	11	46	
	Mannville	3 907	149	86	161	581	337	630	1 548	
	Jurassic	276	54	25	43	15	7	12	34	
	Triassic	287	35	21	49	10	6	14	30	
	Wabamun	966	28	21	37	27	20	36	83	
	Beaverhill Lake	60	183	100	67	11	6	4	21	
	Subtotal					675	390	711	1 776	
Kaybob	Mannville	3 539	24	23	62	84	81	220	385	
	Viking	629	24	24	84	15	15	53	83	
	Upper Devonian	51	-	-	255	-	-	13	13	
	Beaverhill Lake ^a	809	-	-	-	241	232	376	849	
	Subtotal					340	328	662	1 330	

(continued)

^aIncludes gas cycling pool. Gas reserves calculated on an energy basis. Liquid recovery ratios are not included because of parameters changing with time.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Field	Zone	2	3	4	5	6	7	8	9
		Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)			
			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	Total
Kaybob South	Second White Specks	84	60	36	250	5	3	21	29
	Viking	318	35	38	63	11	12	20	43
	Mannville	9 839	63	39	79	621	387	776	1 784
	Triassic	1 119	53	70	58	59	78	65	202
	Jurassic	289	10	10	59	3	3	17	23
	Upper Devonian	363	80	80	636	29	29	231	289
	Nisku	154	78	130	312	12	20	48	80
	Beaverhill Lake ^a	3 747	-	-	-	386	350	1 403	2 139
	Subtotal					1 126	882	2 581	4 589
Knopcik	Viking	254	31	28	91	8	7	23	38
	Mannville	651	6	6	32	4	4	21	29
	Jurassic	1 808	23	25	70	42	46	126	214
	Triassic	7 782	7	5	85	52	38	665	755
	Subtotal					106	95	835	1 036
McLeod	Cardium	1 380	8	8	14	11	11	20	42
	Mannville	3 891	80	53	101	313	206	394	913
	Jurassic	1 267	54	39	155	68	49	196	313
	Subtotal					392	266	610	1 268
Medicine River	Viking	66	136	76	136	9	5	9	23
	Mannville	2 469	92	54	52	227	133	128	488
	Rundle	1 998	98	55	66	195	110	132	437
	Jurassic	1 242	89	52	43	110	64	53	227
	Subtotal					541	312	322	1 175
Minehead	Cardium	3 798	6	14	181	24	53	689	766
	Subtotal					24	53	689	766
Moose	Rundle	3 662	101	78	152	370	284	555	1 209
	Wabamun	201	45	35	60	9	7	12	28
	Subtotal					379	291	567	1 237
Peco	Cardium	436	23	14	576	10	6	251	267
	Viking	185	114	59	86	21	11	16	48
	Mannville	1 747	109	69	318	191	120	555	866
	Jurassic	159	101	57	44	16	9	7	32
	Nisku	855	39	29	29	33	25	25	83
	Other	160	39	2	6	4	2	5	11
	Subtotal					271	171	854	1 296

(continued)

^aIncludes gas cycling pool. Gas reserves calculated on an energy basis. Liquid recovery ratios are not included because of parameters changing with time.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Table 2-4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)											
		1	2	3		4	5	6	7	8	9
			Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)				
Field	Zone			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	Total	
Pembina	Belly River	2 253	83		52	100	188	117	225	530	
	Cardium	3 649	163		116	102	595	424	374	1 393	
	Viking	567	72		46	63	41	26	36	103	
	Mannville	7 378	82		49	180	606	359	1 326	2 291	
	Jurassic	4 496	46		30	180	205	135	811	1 151	
	Rundle	549	11		7	47	6	4	26	36	
	Mississippian	532	117		64	85	62	34	45	141	
	Nisku	5 231	219		106	97	1 147	557	508	2 212	
	Subtotal						2 850	1 656	3 351	7 857	
Pine Creek	Cardium	414	2		2	101	1	1	42	44	
	Second White Specks	137	-		-	161	-	-	22	22	
	Mannville	2 772	53		29	231	148	79	640	867	
	Jurassic	495	16		12	46	8	6	23	37	
	Rundle	172	-		-	110	-	-	19	19	
	Wabamun	634	6		6	27	4	4	17	25	
	Leduc	461	28		37	52	13	17	24	54	
	Other	724	28		2	33	1	1	15	17	
Subtotal						174	107	787	1 068		
Rainbow	Mannville	2 824	3		2	11	8	7	32	47	
	Beaverhill Lake	201	95		55	85	19	11	17	47	
	Sulphur Point	543	79		52	98	43	28	53	124	
	Muskeg	364	192		99	93	70	36	34	140	
	Keg River	8 582	180		93	66	1 542	800	569	2 911	
Subtotal						1 682	882	705	3 269		
Rainbow South	Sulphur Point	343	9		6	64	3	2	22	27	
	Muskeg	322	90		50	65	29	16	21	66	
	Keg River	1 909	145		82	130	277	156	249	682	
Subtotal						309	174	292	775		
Ricinus	Cardium ^a	9 525	-		-	-	456	300	378	1 134	
	Viking	5 469	33		19	43	178	106	235	519	
	Mannville	236	51		25	42	12	6	10	28	
Subtotal						646	412	623	1 681		
Shekelie	Sulphur Point	118	93		59	59	11	7	7	25	
	Keg River	1 801	170		104	99	307	187	178	672	
	Subtotal						318	194	185	697	

(continued)

(continued)

^a Includes gas cycling pool. Gas reserves calculated on an energy basis. Liquid recovery ratios are not included because of parameters changing with time.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Field	Zone	2	3	4	5	6	7	8	9
		Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)			
			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	Total
Simonette	Second White Specks	937	125	55	52	117	52	49	218
	Mannville	608	69	36	53	42	22	32	96
	Wabamun	401	142	102	521	57	41	209	307
	Upper Devonian	35	57	57	171	2	2	6	10
	Leduc	424	318	248	179	135	105	76	316
	Beaverhill Lake	152	178	92	86	27	14	13	54
	Subtotal					380	236	385	1 001
Swan Hills	Beaverhill Lake	1 189	786	481	262	935	572	312	1 819
	Subtotal					935	572	312	1 819
Swan Hills South	Beaverhill Lake	2 102	341	166	61	717	348	129	1 194
	Subtotal					717	348	129	1 194
Sylvan Lake	Second White Specks	51	216	118	39	11	6	2	19
	Viking	88	102	57	80	9	5	7	21
	Mannville	2 933	85	62	76	249	181	222	652
	Rundle	2 529	81	48	63	205	122	159	486
	Jurassic	1 653	105	70	119	174	115	197	486
	Leduc	543	15	15	37	8	8	20	36
	Subtotal					656	437	607	1 700
Turner Valley	Jurassic	119	84	42	25	10	5	3	18
	Mannville	340	124	53	29	42	18	10	70
	Rundle	1 350	267	165	362	360	223	489	1 072
	Subtotal					412	246	502	1 160
Twining	Viking	434	39	18	58	17	8	25	50
	Mannville	565	39	34	88	22	19	50	91
	Rundle	4 542	67	64	90	303	289	410	1 002
	Subtotal					342	316	485	1 143
Valhalla	Second White Specks	1 076	12	10	55	13	11	59	83
	Mannville	2 492	2	1	26	4	3	66	73
	Triassic	10 891	-	-	-	824	373	1 931	3 128
	Mississippian	28	-	-	536	-	-	15	15
	Subtotal					841	387	2 071	3 299
Virginia Hills	Belloy	277	112	61	72	31	17	20	68
	Beaverhill Lake	1 126	516	206	133	581	232	150	963
	Subtotal					612	249	170	1 031

(continued)

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1998 (continued)									
1		2	345			678			9
		Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)			Total
Field	Zone		Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	
Wapiti	Belly River	865	117	58	37	101	50	32	183
	Cardium	975	154	65	24	150	63	23	236
	Viking	139	36	22	43	5	3	6	14
	Lower Cretaceous	2 195	73	44	44	161	97	96	354
	Mannville	9 343	62	35	53	575	324	495	1 394
	Jurassic	2 007	23	14	55	47	28	111	186
	Subtotal					1 039	565	763	2 367
Waterton	Mississippian ^a	4 794	-	-	-	113	91	478	682
	Subtotal					113	91	478	682
Wayne-Rosedale	Viking	960	42	24	29	40	23	28	91
	Mannville	2 866	72	44	52	207	126	148	481
	Nisku	359	123	72	496	44	26	178	248
	Other	2 182	123	8	11	3	3	4	10
	Subtotal					291	175	354	820
Wembley	Second White Specks	347	6	3	72	2	1	25	28
	Triassic ^a	6 315	-	-	-	846	390	1 692	2 928
	Subtotal					848	391	1 717	2 956
Westerose	Mannville	1 322	101	51	58	134	68	77	279
	Mississippian	223	139	76	157	31	17	35	83
	Nisku	86	-	-	151	-	-	13	13
	Subtotal					165	85	125	375
Westerose South	Mannville	2 695	130	66	89	349	178	241	768
	Mississippian	552	22	11	14	12	6	8	26
	Rundle	56	143	71	89	8	4	5	17
	Wabamun	429	26	30	30	11	13	13	37
	Subtotal					380	201	267	848
Westpem	Viking	114	44	26	35	5	3	4	12
	Mannville	1 628	58	31	95	94	51	154	299
	Jurassic	930	20	12	151	19	11	140	170
	Winterburn ^a	650	-	-	-	101	59	101	261
	Subtotal					219	124	399	742
(continued)									

(continued)

^aIncludes gas cycling pool. Gas reserves calculated on an energy basis. Liquid recovery ratios are not included because of parameters changing with time.

Table 2.4. Remaining established reserves of natural gas liquids as of December 31, 1999 (continued)

		1	2	3	4	5	6	7	8	9
			Remaining reserves of marketable gas (10 ⁶ m ³)	Liquid recovery ratio (m ³ /10 ³ m ³ of marketable gas)			Remaining established reserves of natural gas liquids (10 ³ m ³)			
Field	Zone			Propane	Butanes	Pentanes plus	Propane	Butanes	Pentanes plus	Total
Willesden Green	Belly River		988	102	70	58	101	69	57	227
	Cardium		3 696	28	21	113	103	79	418	600
	Second White Specks		685	23	19	23	16	13	16	45
	Mannville		5 011	123	71	140	618	356	703	1 677
	Viking		275	222	127	135	61	35	37	133
	Jurassic		1 457	135	78	222	196	113	323	632
	Rundle		127	94	55	94	12	7	12	31
	Mississippian		323	25	31	133	8	10	43	61
	Subtotal						1 115	682	1 609	3 406
Wizard Lake	Mannville		493	30	16	53	15	8	26	49
	Wabamun		40	125	50	75	5	2	3	10
	Leduc		5 892	347	200	60	2 047	1 178	355	3 580
	Subtotal						2 067	1 188	384	3 639
Subtotal							34 050	23 166	51 728	108 944
Confidential reserves							114	61	91	266
Other small reserves							13 469	8 699	23 058	45 226
Subtotal							47 633	31 926	74 877	154 436
Recoverable at straddle plants							34 730	15 390	7 040	57 160
Recoverable at solvent floods							267	1 278	590	2 135
Total reserves							82 630	48 594	82 507	213 731
							(520.6) ^b	(306.0) ^b	(519.2) ^b	(1 345.8) ^b

^bImperial equivalent in millions of barrels.

3 Reserves of Sulphur

3.1 Provincial Summary

The EUB estimates the remaining established reserves of elemental sulphur in the province as of December 31, 1999, to be some 109.2 million tonnes. The changes in sulphur reserves during the past year are as shown in Table 3.1.

Table 3.1. Reserves of sulphur (10⁶t) as of December 31, 1999

	1999	1998	Change
Initial established reserves			
Natural gas	241.3	238.5	+2.8
Crude bitumen ^a	<u>67.7</u>	<u>42.6</u>	<u>+25.1</u>
Total	309.0	281.1	+27.9
Cumulative net production			
Natural gas	188.7	181.6	+7.1
Crude bitumen ^a	<u>11.1</u>	<u>10.4</u>	<u>+0.7</u>
Total	199.8	192.0	+7.8
Remaining established reserves			
Natural gas	52.6	56.9	-4.3
Crude bitumen ^a	<u>56.6</u>	<u>32.2</u>	<u>+24.4</u>
Total	109.2	89.1	+20.1

^aRecoverable reserves of elemental sulphur under active development at Suncor and Syncrude plants as of December 31, 1999.

3.2 Sulphur from Natural Gas

Sulphur stockpiles had accumulated at various gas plant sites in the province until 1978. When markets became available, these stockpiles were subsequently reduced from their peak in 1978 of 20.3 million tonnes to 2.4 million tonnes in 1991. Since then, sustained low prices for sulphur have caused the resumption of stockpiling. The sulphur stockpiled at year-end 1999 was 11.9 million tonnes, some 0.7 million tonnes greater than at year-end 1998.

The EUB recognizes 52.6 million tonnes of remaining established sulphur from conventional gas reserves at year-end 1999. This estimate from gas has been prepared by applying the appropriate hydrogen sulphide (H₂S) content and sulphur recovery efficiency to the remaining established reserves of raw gas in each pool. Where sulphur is currently being recovered, historical recovery efficiencies have been used. Where sulphur recovery is anticipated from gas reserves not yet being produced, the recovery efficiency has been estimated on the basis of the minimum sulphur recovery efficiency guidelines published in the EUB *Informational Letter (IL) 88-13*. The remaining established reserves of sulphur for cycling schemes were determined from a detailed assessment of each pool, but because the H₂S content in the gas changes with time, only the remaining sulphur reserves are

reported. The EUB estimates the ultimate potential for sulphur from conventional gas to be 330 million tonnes and from ultra-high H₂S pools to be 40 million tonnes. This leaves sulphur reserves of 128.7 million tonnes yet to be established from future discoveries of conventional gas.

The EUB's reserve estimates from natural gas are shown in Table 3.2. Fields containing 800 000 tonnes or more of recoverable sulphur are listed individually and those containing less are grouped under other small reserves. For historical reasons, some fields containing less than 800 000 tonnes of recoverable sulphur have also been included in this table. Sulphur reserves declined most notably in the Caroline, Crossfield East, and Gold Creek fields as a result of production.

3.3 Sulphur from Crude Bitumen

Crude bitumen in oil sands deposits contains significant amounts of sulphur. As a result of current upgrading operations in which bitumen is converted to synthetic crude oil, an average of 90 per cent of the sulphur contained in the crude bitumen is either recovered in the form of elemental sulphur or remains in products including coke.

It is currently estimated that some 211 million tonnes of elemental sulphur will be recoverable from the 5.2 billion cubic metres of remaining established crude bitumen reserves in the surface-mineable area. These sulphur reserves were estimated by multiplying the remaining established reserves of crude bitumen by a factor of 40.5 tonnes per thousand cubic metres of crude bitumen. In 1989, this ratio was revised from previous estimates to reflect both current operations and the expected use of high-conversion hydrogen-addition upgrading technologies for the future development of surface-mineable crude bitumen reserves. Hydrogen-addition technology yields a higher elemental sulphur production than does an alternative carbon-rejection technology, since a larger percentage of the sulphur in the bitumen remains in upgrading residues, as opposed to being converted to H₂S.

3.4 Sulphur from Crude Bitumen Reserves Under Active Development

Only a portion of the surface-mineable established crude bitumen reserves is under active development at the approved Suncor, Syncrude, and Shell projects. The EUB has estimated the initial established reserves from these projects to be 67.7 million tonnes, an increase of 25.1 million tonnes from 1998. This increase is due to expansion of the Suncor Steepbank/Millennium and Syncrude Aurora projects and the addition of the Shell Muskeg River project. Table 3.2 shows the amount of sulphur added for each project. A total of 11.1 million tonnes of elemental sulphur have been produced from these projects, leaving a remaining established reserve of 56.6 million tonnes. During 1999, 0.7 million tonnes of elemental sulphur were produced at the Suncor and Syncrude projects, the Shell project is still to come on stream.

Table 3.2 Addition of sulphur (10⁶ t) from crude bitumen under active development

Projects	Volume
Suncor Steepbank/Millennium	14.8
Syncrude Aurora	1.8
Shell Muskeg River	<u>8.5</u>
Total	25.1

Table 3.3. Remaining established reserves of sulphur as of December 31, 1999

Field	Zone	Remaining established reserves of raw gas (10 ⁶ m ³)	H ₂ S content ^a (mol/mol)	Recovery efficiency ^b (%)	Remaining established reserves of sulphur (10 ³ t)
Benjamin	Mississippian	4 261	0.063	98	354
	Wabamun	1 070	0.441	98	<u>627</u>
	Subtotal				981
Blackstone	Beaverhill Lake	13 027	0.107	98	<u>1 856</u>
	Subtotal				1 856
Brazeau River	Mississippian	2 742	0.010	99	37
	Nisku ^c	-	-	-	<u>1 427</u>
	Subtotal				1 464
Burmis	Mississippian	7 543	0.551	99	5 575
	Wabamun	451	0.117	95	<u>68</u>
	Subtotal				5 643
Caroline	Mississippian	612	0.017	93	13
	Leduc	954	0.227	96 ^c	292
	Beaverhill Lake	27 839	0.335	100 ^c	<u>13 774</u>
	Subtotal				14 081
Coleman	Mississippian	3 252	0.279	99	1 218
	Wabamun	1 137	0.279	99	<u>426</u>
	Subtotal				1 644
Crossfield	Mannville	1 609	0.009	99	20
	Mississippian	2 400	0.007	99	16
	Wabamun	3 828	0.316	99	<u>1 626</u>
	Subtotal				1 662
Crossfield East	Mannville	245	0.001	99	3
	Wabamun	1 204	0.351	99	<u>567</u>
	Subtotal				570
Gold Creek	Wabamun	4 648	0.077	98	<u>478</u>
	Subtotal				478
Hanlan	Winterburn	218	0.051	99	15
	Beaverhill Lake	12 863	0.092	99	<u>1 588</u>
	Subtotal				1 603
					(continued)

^aVolume-weighted average.

^bAll recovery efficiencies are rounded to the nearest whole percentage.

^cIncludes gas-cycling pool. Gas reserves are calculated on an energy basis. H₂S content is not included because of gas composition changing with time.

Table 3.3. Remaining established reserves of sulphur as of December 31, 1999 (continued)

Field	Zone	Remaining established reserves of raw gas (10 ⁶ m ³)	H ₂ S content ^a (mol/mol)	Recovery efficiency ^b (%)	Remaining established reserves of sulphur (10 ³ t)
Jumping Pound West	Mississippian	12 975	0.063	97	<u>1 079</u>
	Subtotal				1 079
Kaybob South	Triassic	1 271	0.009	98	16
	Winterburn	843	0.192	99	217
	Beaverhill Lake ^c	-	-	-	<u>890</u>
	Subtotal				1 123
Limestone	Mississippian	4 427	0.044	99	260
	Wabamun	1 507	0.155	99	314
	Winterburn	182	0.119	99	29
	Leduc	323	0.178	99	<u>77</u>
	Subtotal				680
Moose	Mississippian	4 395	0.191	99	1 125
	Wabamun	335	0.329	99	<u>148</u>
	Subtotal				1 273
Okotoks	Wabamun	1 927	0.318	99	<u>823</u>
	Subtotal				823
Pine Creek	Jurassic	402	0.002	99	1
	Triassic	85	0.009	99	1
	Mississippian	300	0.025	98	10
	Wabamun	996	0.274	99	367
	Leduc	639	0.185	99	159
	Beaverhill Lake	509	0.192	95	<u>126</u>
	Subtotal				664
Ricinus West	Leduc	2 371	0.003	99	<u>1 057</u>
	Subtotal				1 057
Waterton	Mississippian	8 213	0.197	99	2 107
	Wabamun	1 137	0.147	99	224
	Rundle-Wabamun ^c	-	-	-	<u>2 83</u>
	Subtotal				2 677
Subtotal					39 358
Other small reserves					<u>13 204</u>
Total reserves					52 562

^aVolume-weighted average.

^bAll recovery efficiencies are rounded to the nearest whole percentage.

^cIncludes gas-cycling pool. Gas reserves are calculated on an energy basis. H₂S content is not included because of gas composition changing with time.

4 Terminology

4.1 Symbols

SI

°C	degree Celsius
d	day
ha	hectare
J	joule
kg	kilogram
kPa	kilopascal

M	mega
m	metre
mol	mole
T	tera
t	tonne

Imperial

bbl	barrel	°F	degree Fahrenheit
Btu	British thermal unit	psia	pounds per square inch absolute
cf	cubic foot	psig	pounds per square inch gauge
d	day	stb	stock-tank barrel

4.2 SI Units

Data in *Alberta's Reserves* are presented using the International System of Units (SI). The provincial totals and a few other major totals are shown in both SI units and the imperial equivalents in the various tables.

Conversion factors used in calculating the imperial equivalents are listed below:

1 m ³ of gas (101.325 kPa and 15°C)	= 35.493 73 cubic feet of gas (14.65 psia and 60°F)
1 m ³ of ethane (equilibrium pressure and 15°C)	= 6.33 Canadian barrels of ethane (equilibrium pressure and 60°F)
1 m ³ of propane (equilibrium pressure and 15°C)	= 6.300 0 Canadian barrels of propane (equilibrium pressure and 60°F)
1 m ³ of butanes (equilibrium pressure and 15°C)	= 6.296 8 Canadian barrels of butanes (equilibrium pressure and 60°F)
1 m ³ of oil or pentanes plus (equilibrium pressure and 15°C)	= 6.292 9 Canadian barrels of oil or pentanes plus (equilibrium pressure and 60°F)
1 m ³ of water (equilibrium pressure and 15°C)	= 6.290 1 Canadian barrels of water (equilibrium pressure and 60°F)
1 tonne	= 0.984 206 4 (U.K.) long tons (2240 pounds)
1 tonne	= 1.102 311 short tons (2000 pounds)
1 kilojoule	= 0.948 213 3 British thermal units (Btu as defined in the federal Gas Inspection Act (60°-61°F))

4.3 Reserves Terminology

The reserves terminology used in this report applies to all fossil energy resources (including coal) and is as follows:

Initial Volume in Place: The volume of crude oil, crude bitumen, or raw natural gas calculated or interpreted to exist in a reservoir before any volume has been produced.

Established Reserves: Those reserves recoverable under current technology and present and anticipated economic conditions specifically proved by drilling, testing, or production, plus the portion of contiguous recoverable reserves that are interpreted to exist from geological, geophysical, or similar information with reasonable certainty.

Initial Established Reserves: Established reserves prior to the deduction of any production.

Remaining Established Reserves: Initial established reserves less cumulative production.

Ultimate Potential: An estimate of the initial established reserves that will have been developed in an area by the time all exploratory and development activity has ceased, having regard for the geological prospects of that area and anticipated technology and economic conditions.

Ultimate potential includes cumulative production, remaining established reserves, and future additions through extensions and revisions to existing pools and the discovery of new pools. Ultimate potential can be expressed by the following simple equation:
$$\text{Ultimate potential} = \text{initial established reserves} + \text{additions to existing pools} + \text{future discoveries}.$$

The above terminology and definitions were recommended by the Inter-Provincial Advisory Committee on Energy and adopted by the EUB.

4.4 Other Terminology

Area	The area used to determine the bulk rock volume of the oil-, crude bitumen-, or gas-bearing reservoir, usually the area of the zero isopach or the assigned area of a pool or deposit.
Butanes	In addition to its normal scientific meaning, a mixture mainly of butanes that ordinarily may contain some propane or pentanes plus (Oil and Gas Conservation Act, Section 1(1)(c.1)).
Compressibility Factor	A correction factor for nonideal gas determined for gas from a pool at its initial reservoir pressure and temperature and, where necessary, including factors to correct for acid gases.
Condensate	A mixture mainly of pentanes and heavier hydrocarbons that may be contaminated with sulphur compounds and is recovered or is recoverable at a well from an underground reservoir. It may be gaseous in its virgin reservoir state but is liquid at the conditions under which its volume is measured or estimated (Oil and Gas Conservation Act, Section 1(1)(d.1)).

Crude Bitumen	A naturally occurring viscous mixture mainly of hydrocarbons heavier than pentane that may contain sulphur compounds and that in its naturally occurring viscous state will not flow to a well (Oil Sands Conservation Act, Section 1(1)(f)).
Crude Oil (Conventional)	A mixture mainly of pentanes and heavier hydrocarbons that may be contaminated with sulphur compounds and is recovered or is recoverable at a well from an underground reservoir. It is liquid at the conditions under which its volume is measured or estimated and includes all other hydrocarbon mixtures so recovered or recoverable except raw gas, condensate, or crude bitumen (Oil and Gas Conservation Act, Section 1(1)(f.1)).
Crude Oil (Heavy)	Crude oil is deemed to be heavy crude oil if it has a density of 900 kg/m ³ or greater, but the EUB may classify crude oil otherwise than in accordance with this criterion in a particular case, having regard to its market utilization and purchasers' classification.
Crude Oil (Light-Medium)	Crude oil is deemed to be light-medium crude oil if it has a density of less than 900 kg/m ³ , but the EUB may classify crude oil otherwise than in accordance with this criterion in a particular case, having regard to its market utilization and purchasers' classification.
Crude Oil (Synthetic)	A mixture mainly of pentanes and heavier hydrocarbons that may contain sulphur compounds and is derived from crude bitumen. It is liquid at the conditions under which its volume is measured or estimated and includes all other hydrocarbon mixtures so derived (Oil and Gas Conservation Act, Section 1(1)(t.1)).
Datum Depth	The approximate average depth relative to sea level of the midpoint of an oil or gas productive zone for the wells in a pool.
Density	The mass or amount of matter per unit volume.
Density, Relative (Raw Gas)	The density relative to air of raw gas upon discovery, determined by an analysis of a gas sample representative of a pool under atmospheric conditions.
Discovery Year	The year when drilling was completed of the well in which the oil or gas pool was discovered.
Ethane	In addition to its normal scientific meaning, a mixture mainly of ethane that ordinarily may contain some methane or propane (Oil and Gas Conservation Act, Section 1(1)(h.1)).
Feedstock	Raw material supplied to a refinery or petrochemical plant.
Field Plant	A plant located near the source of gas that processes raw gas and is located upstream of pipelines that move the gas to markets. Some of these plants extract ethane.

Fractionation Plant	A processing facility that takes an natural gas liquids stream and separates out the component parts as specification products.
Gas	Raw gas, marketable gas, or any constituent of raw gas, condensate, crude bitumen, or crude oil that is recovered in processing and is gaseous at the conditions under which its volume is measured or estimated (Oil and Gas Conservation Act, Section 1(1)(j.1)).
Gas (Associated)	Gas in a free state in communication in a reservoir with crude oil under initial reservoir conditions.
Gas (Marketable)	A mixture mainly of methane originating from raw gas, or if necessary from the processing of the raw gas for the removal or partial removal of some constituents, and that meets specifications for use as a domestic, commercial, or industrial fuel or as an industrial raw material (Oil and Gas Conservation Act, Section 1(1)(m)).
Gas (Marketable at 101.325 kPa and 15°C)	The equivalent volume of marketable gas at standard conditions.
Gas (Nonassociated)	Gas that is not in communication in a reservoir with an accumulation liquid hydrocarbons at initial reservoir conditions.
Gas (Raw)	A mixture containing methane, other paraffinic hydrocarbons, nitrogen, carbon dioxide, hydrogen sulphide, helium, and minor impurities, or some of these components, that is recovered or is recoverable at a well from an underground reservoir and is gaseous at the conditions under which its volume is measured or estimated (Oil and Gas Conservation Act, Section 1(1)(s.1)).
Gas (Solution)	Gas that is dissolved in crude oil under reservoir conditions and evolves as a result of pressure and temperature changes.
Gas-Oil Ratio (Initial Solution)	The volume of gas (in cubic metres, measured under standard conditions) contained in one stock-tank cubic metre of oil under initial reservoir conditions.
Good Production Practice (GPP)	<p>Production of crude oil or raw gas at a rate</p> <ul style="list-style-type: none"> (i) not governed by a base allowable, but (ii) limited to what can be produced without adversely and significantly affecting conservation, the prevention of waste, or the opportunity of each owner in the pool to obtain its share of the production (Oil and Gas Conservation Regulation 1.020(2)9).

This practice is authorized by the EUB either to improve the economics of production from a pool and thus defer its abandonment or to avoid unnecessary administrative expense associated with regulation or production restrictions where this serves little or no purpose.

Gross Heating (of Dry Gas)	The heat liberated by burning moisture-free gas at standard conditions and condensing the water vapour to a liquid state.
Mean Formation Depth	The approximate average depth below kelly bushing of the midpoint of an oil or gas productive zone for the wells in a pool.
Methane	In addition to its normal scientific meaning, a mixture mainly of methane that ordinarily may contain some ethane, nitrogen, helium, or carbon dioxide (Oil and Gas Conservation Act, Section 1(1)(m.1)).
Natural Gas Liquids	Propane, butanes, pentanes plus, or a combination of these obtained from the processing of raw gas or condensate (Oil and Gas Conservation Act, Section 1(1)(n)).
Oil	Condensate, crude oil, or a constituent of raw gas, condensate, or crude oil that is recovered in processing and is liquid at the conditions under which its volume is measured or estimated (Oil and Gas Conservation Act, Section 1(1)(n.1)).
Oil Sands	<ul style="list-style-type: none"> (i) sands and other rock materials containing crude bitumen, (ii) the crude bitumen contained in those sands and other rock materials, and (iii) any other mineral substances other than natural gas in association with that crude bitumen or those sands and other rock materials referred to in subclauses (i) and (ii) (Oil Sands Conservation Act, Section 1(1)(o)).
Oil Sands Deposit	A natural reservoir containing or appearing to contain an accumulation of oil sands separated or appearing to be separated from any other such accumulation (Oil and Gas Conservation Act, Section 1(1)(o.1)).
Pay Thickness (Average)	The bulk rock volume of a reservoir of oil, oil sands, or gas divided by its area.
Pentanes Plus	A mixture mainly of pentanes and heavier hydrocarbons that ordinarily may contain some butanes and is obtained from the processing of raw gas, condensate, or crude oil (Oil and Gas Conservation Act, Section 1(1)(p)).
Pool	A natural underground reservoir containing or appearing to contain an accumulation of oil or gas or both separated or appearing to be separated from any other such accumulation (Oil and Gas Conservation Act, Section 1(1)(q)).
Porosity	The effective pore space of the rock volume determined from core analysis and well log data measured as a fraction of rock volume.
Pressure (Initial)	The reservoir pressure at the reference elevation of a pool upon discovery.

Propane	In addition to its normal scientific meaning, a mixture mainly of propane that ordinarily may contain some ethane or butanes (Oil and Gas Conservation Act, Section 1(1)(s)).
Recovery (Enhanced)	The increased recovery from a pool achieved by artificial means or by the application of energy extrinsic to the pool. The artificial means or application includes pressuring, cycling, pressure maintenance, or injection to the pool of a substance or form of energy but does not include the injection in a well of a substance or form of energy for the sole purpose of <ul style="list-style-type: none"> (i) aiding in the lifting of fluids in the well, or (ii) stimulation of the reservoir at or near the well by mechanical, chemical, thermal or explosive means (Oil and Gas Conservation Act, Section 1(1)(h)).
Recovery (Pool)	In gas pools, the fraction of the in-place reserves of gas expected to be recovered under the subsisting recovery mechanism.
Recovery (Primary)	Recovery of oil by natural depletion processes only measured as a volume thus recovered or as a fraction of the in-place oil.
Saturation (Gas)	The fraction of pore space in the reservoir rock occupied by gas upon discovery.
Saturation (Water)	The fraction of pore space in the reservoir rock occupied by water upon discovery.
Shrinkage Factor (Initial)	The volume occupied by one cubic metre of oil from a pool measured at standard conditions after flash gas liberation consistent with the surface separation process and divided by the volume occupied by the same oil and gas at the pressure and temperature of a pool upon discovery.
Solvent	A suitable mixture of hydrocarbons ranging from methane to pentanes plus but consisting largely of methane, ethane, propane, and butanes for use in enhanced-recovery operations.
Straddle Plant	A gas processing plant located on a main gas transmission pipeline that extracts natural gas liquids.
Surface Loss	A summation of the fractions of recoverable gas that is removed as acid gas and liquid hydrocarbons and is used as lease or plant fuel or is flared.
Temperature	The initial reservoir temperature upon discovery at the reference elevation of a pool.
Zone	Any stratum or sequence of strata that is designated by the EUB as a zone (Oil and Gas Conservation Act, Section 1(1)(z)).

4.5 Standard Conditions of Gas Measurement

Volumes of gas are given as at a standard pressure and temperature of 101.325 kPa and 15°C respectively.

4.6 Abbreviations

General Report

GIP	gas in place
GPP	good production practice
RF	recovery factor
RGE	range
STP	standard temperature and pressure
TWP	township
WM	west of a certain meridian

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ABAND	abandoned
ADMIN 2	Administrative Area No. 2
ASSOC	associated gas
BDY	boundary
BELL	Belloy
BER	beyond economic reach
BLAIR	Blairmore
BLSKY OR BLSK	Bluesky
BLUE	Blueridge
BNFF	Banff
BOW ISL or BI	Bow Island
BR	Belly River
BSL COLO	Basal Colorado
BSL MANN, BMNV or BMN	Basal Mannville
BSL QTZ	Basal Quartz
CADM or CDN	Cadomin
CARD	Cardium
CDOT	Cadotte
CH LK	Charlie Lake
CLWTR	Clearwater
CLY or COL	Colony
CMRS	Camrose
COMP	compressibility
DBLT	Debolt
DETR	Detrital
DISC YEAR	discovery year
ELRSL, ELERS or ELRS	Ellerslie
ELTN or ELK	Elkton
ERSO	enhanced-recovery scheme is in operation but no additional established reserves are attributed
FALH	Falher
FRAC	fraction
GEN PETE or GEN PET	General Petroleum
GETH or GET	Gething
GLAUC or GLC	Glaucinitic
GLWD	Gilwood

GOR	gas-oil ratio
GRD RAP or GRD RP	Grand Rapids
GROSS HEAT VALUE	gross heating value
GSMT	Grosmont
ha	hectare
HFWD	Halfway
INJ	injected
I.S.	integrated scheme
JUR or J	Jurassic
KB	kelly bushing
KISK	Kiskatinaw
KR	Keg River
LED	Leduc
LF	load factor
LIV	Livingston
LLOYD	Lloydminster
LMNV, LMN or LM	Lower Mannville
LOC EX PROJECT	local experimental project
LOC U	local utility
LOW or L	lower
LUSC	Luscar
MANN or MN	Mannville
MCM	McMurray
MED HAT	Medicine Hat
MID or M	middle
MILK RIV	Milk River
MOP	maximum operating pressure
MSKG	Muskeg
MSL	mean sea level
NGL	natural gas liquids
NIKA	Nikanassin
NIS	Nisku
NO.	number
NON-ASSOC	non-associated gas
NORD	Nordegg
NOTIK, NOTI or NOT	Notikewin
OST	Ostracod
PALL	Palliser
PEK	Pekisko
PM-PN SYS	Permo-Penn System
RF	recovery factor
RK CK	Rock Creek
RUND or RUN	Rundle
SA	strike area
SATN	saturation
SD	sandstone
SE ALTA GAS SYS (MU)	Southeastern Alberta Gas System - commingled
SG	gas saturation
SHUN	Shunda
SL	surface loss
SL PT	Slave Point
SOLN	solution gas

SPKY
 ST. ED
 SULPT
 SUSP
 SW
 SW HL
 TEMP
 TOT
 TV
 TVD
 UIRE
 UMN, UMN or UM
 UP or U
 VIK or VK
 VOL
 WAB
 WBSK
 WINT
 WTR DISP
 WTR INJ
 1ST WHITE SPKS OR 1WS
 2WS

Company Names

AEC
 AEL
 ALTAGAS
 ALTROAN

AMOCO
 APACHE
 BARRING
 BEAU
 BLUERGE
 CAN88
 CANOR
 CANOXY
 CANST
 CDNFRST
 CENTRA
 CGGS
 CHEL
 CHEVRON
 CMG
 CNRL
 CNWE
 CONOCO
 CRESTAR
 CTYMEDH
 CWNG

Sparky
 St. Edouard
 Sulphur Point
 suspended
 water saturation
 Swan Hills
 temperature
 total
 Turner Valley
 true vertical depth
 Upper Ireton
 Upper Mannville
 upper
 Viking
 volume
 Wabamun
 Wabiskaw
 Winterburn
 water disposal
 water injection
 First White Specks
 Second White Specks

Alberta Energy Company Ltd.
 Anderson Exploration Ltd.
 AltaGas Marketing Inc.
 Altana Exploration Company/Roan Resources Ltd.
 Amoco Canada Petroleum Company Ltd.
 Apache Canada Ltd.
 Barrington Petroleum Ltd.
 Beau Canada Exploration Ltd.
 Blue Range Resource Corporation
 Canadian 88 Energy Corp.
 Canor Energy Ltd.
 Canadian Occidental Petroleum Ltd.
 Canstates Gas Marketing
 Canadian Forest Oil Ltd.
 Centra Gas Alberta Inc.
 Canadian Gas Gathering Systems Inc.
 Canadian Hunter Exploration Ltd.
 Chevron Canada Resources
 Canadian-Montana Gas Company Limited
 Canadian Natural Resources Limited
 Canada Northwest Energy Limited
 Conoco Canada Limited
 Crestar Energy Inc.
 City of Medicine Hat
 Canadian Western Natural Gas Company Limited and Northwestern Utilities Limited

DART	Dartmouth Power Associates Limited Partnership
DIRECT	Direct Energy Marketing Limited
DUKE	Duke Energy Marketing Limited Partnership
DYNALTA	Dynalta Energy Corporation
ENCAL	Encal Energy Ltd.
ENGAGE	Engage Energy Canada, L.P.
ENRMARK	EnerMark Inc.
GARDNER	Gardiner Oil and Gas Limited
GULF	Gulf Canada Resources Limited
HUSKY	Husky Oil Ltd.
IOL	Imperial Oil Resources Limited
LOMALTA	Lomalta Petroleums Ltd.
MARTHON	Marathon International Petroleum Canada, Ltd.
METGAZ	Metro Gaz Marketing
MOBIL	Mobil Oil Canada
NOVERGZ	Novergaz
NRTHSTR	Northstar Energy Corporation
PANALTA	Pan-Alberta Gas Ltd.
PANCDN	PanCanadian Petroleum Limited
PARAMNT	Paramount Resources Ltd.
PAWTUCK	Pawtucket Power Associates Limited Partnership
PCOG	Petro-Canada Oil and Gas
PENWEST	Penn West Petroleum Ltd.
PETRMET	Petromet
PIONEER	Pioneer Natural Resources Canada Ltd.
POCO	Poco Petroleums Ltd.
PROGAS	ProGas Limited
QUEBEC	3091-9070 Quebec
RANGER	Ranger Oil Limited
RENENER	Renaissance Energy Ltd.
RIFE	Rife Resources Ltd.
RIGEL	Rigel Oil & Gas Ltd.
RIOALTO	Rio Alta Exploration Ltd.
SASKEN	SaskEnergy Incorporated
SHELL	Shell Canada Limited
SHERRIT	Sherritt Inc.
SIMPLOT	Simplot Canada Limited
SUMMIT	Summit Resources Limited
SUNCOR	Suncor Energy Inc. (Oil Sands Group)
SYNCRUDE	Syncrude Canada Ltd.
TALISMA	Talisman Energy Inc.
TCPL	TransCanada PipeLines Limited
ULSTER	Ulster Petroleums Ltd.
UNPACF	Union Pacific Resources Inc.
UNOCAL	Unocal Canada Limited
WAINOCO	Wainoco Oil Corporation
WASCANA	Wascana Energy Inc.

